

## CLAIMS

1           1.     A method of utilizing model based intelligent agents for  
2     diagnosing and isolating malfunctions in a computer-controlled machinery  
3     comprising the steps of:

4                 disposing a plurality of intelligent agents in the computer controlled  
5     machinery wherein the plurality of agents are disposed in a plurality of  
6     hierarchical levels wherein each intelligent agent has diagnostic capability  
7     relative to the hierarchical level the intelligent agent is disposed in, and  
8     wherein said plurality of intelligent agents are in data communication with  
9     computer controllers of the machinery and with each other;

10                collecting data from a plurality of computer controllers disposed within  
11     the computer controlled machinery via at least one of intelligent agent disposed  
12     in a first hierarchical level wherein said collected data is analyzed to obtain a  
13     first level of diagnostic information and wherein said first level of diagnostic  
14     information is communicated to at least one intelligent agent disposed in a  
15     second hierarchical level;

16                employing said at least one intelligent agent disposed in said second  
17     hierarchical level to perform a second level of diagnostic tasks on the first level  
18     of diagnostic information to obtain a second level of diagnostic information  
19     and wherein said second level of diagnostic information is communicated to at  
20     least one intelligent agent disposed in a third hierarchical level;

21                employing said at least one intelligent agent disposed in said third  
22     hierarchical level to perform a third level of diagnostic tasks using said second

23 level of diagnostic information wherein said third level of diagnostic tasks  
24 includes analyzing said second level of diagnostic information relative to  
25 reference information to accomplish fault isolation within the computer  
26 controlled machinery.

1           2.     The method of claim 1 wherein the diagnostic capability of the  
2     at least one intelligent agent disposed in the first hierarchical level includes the  
3     capability to collect and analyze data to accomplish a first level of fault  
4     isolation.

1           3.     The method of claim 2 wherein the diagnostic capability of the  
2     at least one intelligent agent disposed in the second hierarchical level includes  
3     the capability to collect and analyze data to accomplish a second level of fault  
4     isolation wherein said second level of fault isolation surpasses said first level of  
5     fault isolation.

1           4.     The method of claim 3 wherein the diagnostic capability of the  
2     at least one intelligent agent disposed in the third hierarchical level includes the  
3     capability to collect and analyze data to accomplish a third level of fault  
4     isolation wherein said third level of fault isolation surpasses said second level  
5     of fault isolation.

1           5.     The method of claim 1 wherein the intelligent agents are in  
2     wireless data communication.

1           6.     The method of claim 1 wherein the computer controllers include  
2     diagnostic capability wherein said diagnostic capability is provided in at least  
3     one Application Specific Integrated Circuit (ASIC).

1           7.     The method of claim 1 wherein the second level of diagnostic  
2     tasks includes identifying a failure model relative to the first level of diagnostic  
3     information.

1           8.     The method of claim 7 wherein the third level of diagnostic  
2     tasks includes using analyzing said failure model relative to reference  
3     information disposed within the at least one intelligent agent disposed in the  
4     third hierarchical level or reference information obtained from a remote central  
5     knowledge facility.

1           9.     The method of claim 1 wherein the second level of diagnostic  
2     tasks includes reorganizing the at least one intelligent agent disposed in the  
3     first hierarchical level.

1           10.    The method of claim 9 wherein reorganization involves re-  
2     tasking at least one intelligent agent to perform diagnostic tasks on at least one

3 computer controller that the at least one intelligent agent was not previously  
4 performing diagnostic tasks on.

1 11. The method of claim 8 wherein the at least one intelligent agent  
2 disposed in the third hierarchical level obtains reference information from the  
3 remote central knowledge facility through a wireless communications link.

1 12. The method of claim 1 further comprising providing a data link  
2 to at least one fault indicator operative to alert a user of the computer  
3 controlled machinery that a fault has occurred.

1 13. A method of utilizing model based intelligent agents for  
2 diagnosing and isolating malfunctions in a vehicle comprising the steps of:  
3 disposing a plurality of intelligent agents in the vehicle wherein the  
4 plurality of agents are disposed in a plurality of hierarchical levels wherein  
5 each intelligent agent has diagnostic capability relative to the hierarchical level  
6 the intelligent agent is disposed in, and wherein said plurality of intelligent  
7 agents are in data communication with computer controllers of the vehicle and  
8 with each other;  
9 collecting data from a plurality of computer controllers disposed within  
10 the vehicle via at least one of intelligent agent disposed in a first hierarchical  
11 level wherein said collected data is analyzed to obtain a first level of diagnostic  
12 information and wherein said first level of diagnostic information is

13       communicated to at least one intelligent agent disposed in a second hierarchical  
14       level;

15               employing said at least one intelligent agent disposed in said second  
16       hierarchical level to perform a second level of diagnostic tasks wherein said  
17       second level of diagnostic tasks includes reorganizing the at least one  
18       intelligent agent disposed in the first hierarchical level to obtain a second level  
19       of diagnostic information wherein reorganization involves re-tasking at least  
20       one intelligent agent to perform diagnostic tasks on at least one computer  
21       controller that the at least one intelligent agent was not previously performing  
22       diagnostic tasks on, and wherein said second level of diagnostic information is  
23       communicated to at least one intelligent agent disposed in a third hierarchical  
24       level;

25               employing said at least one intelligent agent disposed in said third  
26       hierarchical level to perform a third level of diagnostic tasks using said second  
27       level of diagnostic information wherein said third level of diagnostic tasks  
28       includes analyzing said second level of diagnostic information relative to  
29       reference information to accomplish fault isolation within the vehicle.

1               14.     The method of claim 13 wherein the diagnostic capability of the  
2       at least one intelligent agent disposed in the first hierarchical level includes the  
3       capability to collect and analyze data to accomplish a first level of fault  
4       isolation.

1           15.    The method of claim 14 wherein the diagnostic capability of the  
2    at least one intelligent agent disposed in the second hierarchical level includes  
3    the capability to collect and analyze data to accomplish a second level of fault  
4    isolation wherein said second level of fault isolation surpasses said first level of  
5    fault isolation.

1           16.    The method of claim 15 wherein the diagnostic capability of the  
2    at least one intelligent agent disposed in the third hierarchical level includes the  
3    capability to collect and analyze data to accomplish a third level of fault  
4    isolation wherein said third level of fault isolation surpasses said second level  
5    of fault isolation.

1           17.    The method of claim 13 further comprising providing a data link  
2    to at least one fault indicator operative to alert a user of the vehicle that a fault  
3    has occurred.